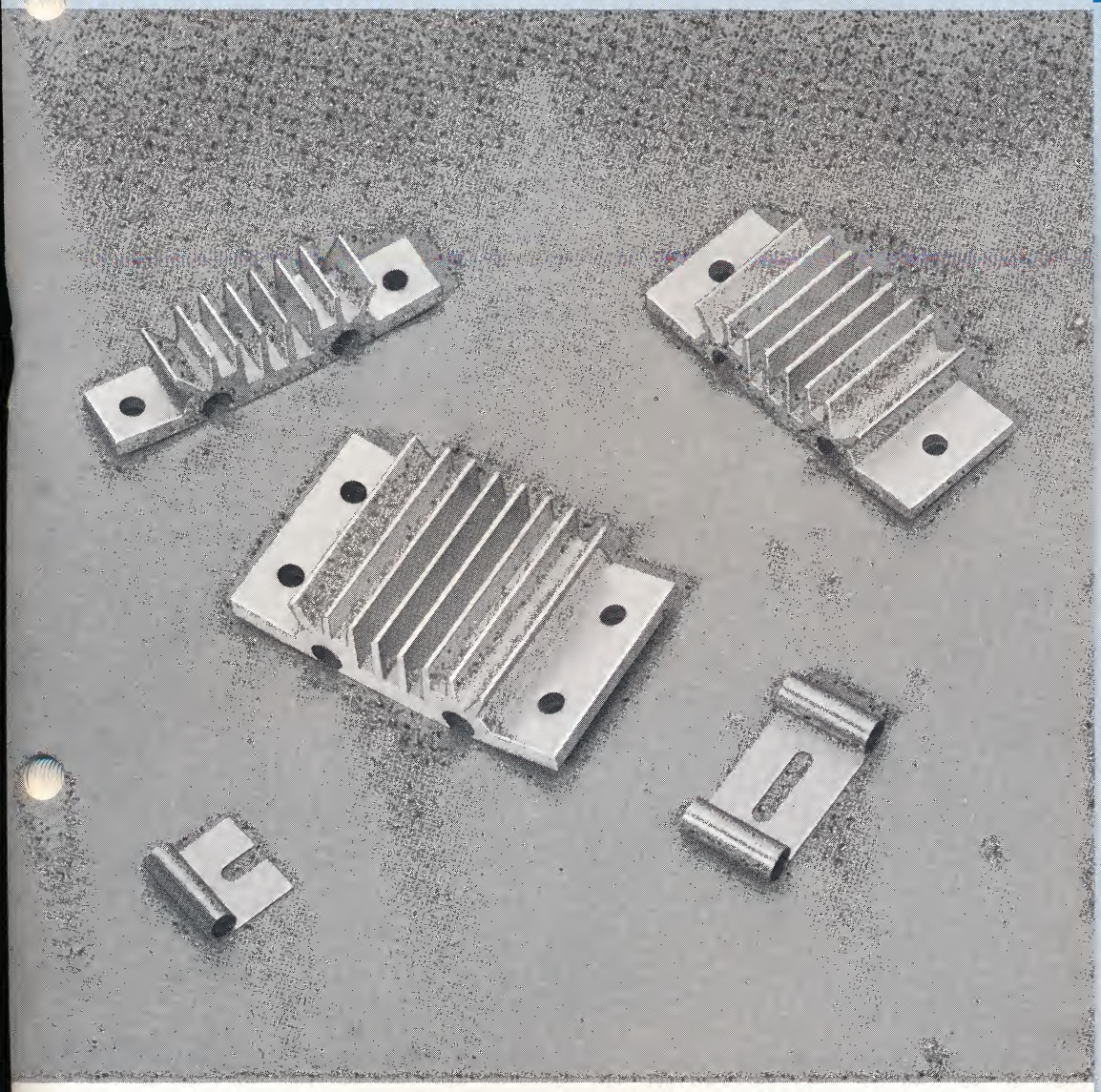
Amperex® ELECTRONIC CORPORATION
SEMICONDUCTOR AND RECEIVING TUBE DIVISION
SLATERSVILLE, RHODE ISLAND 02876 401/POplar 2-9000

TRANSISTOR
HEAT SINKS



TRANSISTOR
Heat Sinks

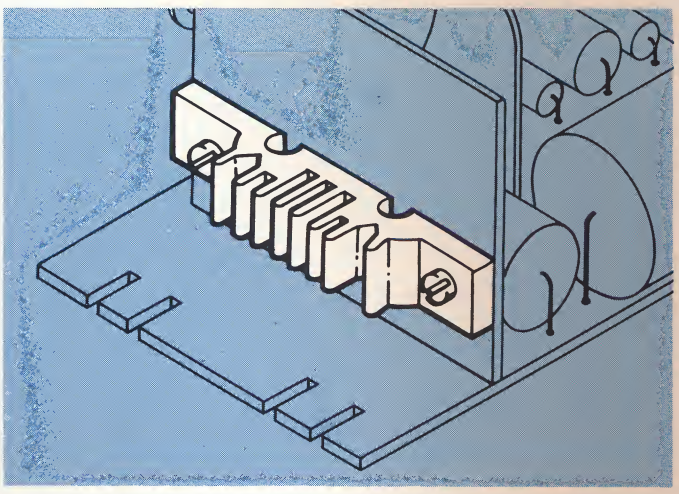
Amperex Extruded Aluminum Heat Sinks

- Grip the transistor for better bond
- Provide maximum heat dissipation
- Are installed easily
- Are available in three sizes. (Custom made Heat Sinks are also available)

For lower cooling demands, Amperex clip-on Cooling Fins of Nickel Plated Brass

- Fit into smaller areas
- Are available in two types for single or dual transistor mounting

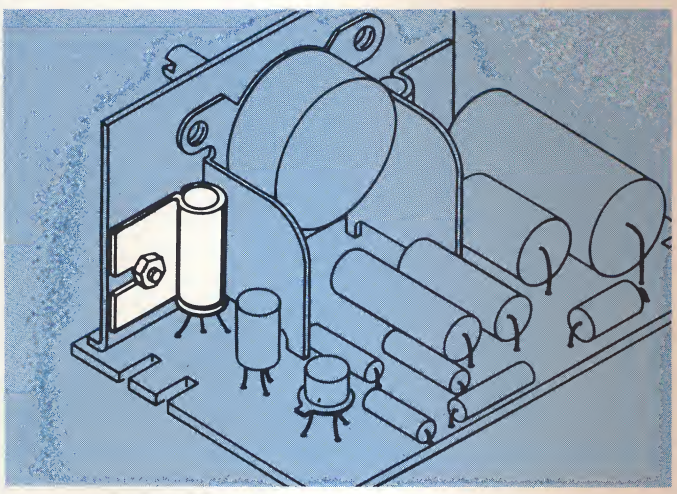
typical installations



AMPEREX

HS-3

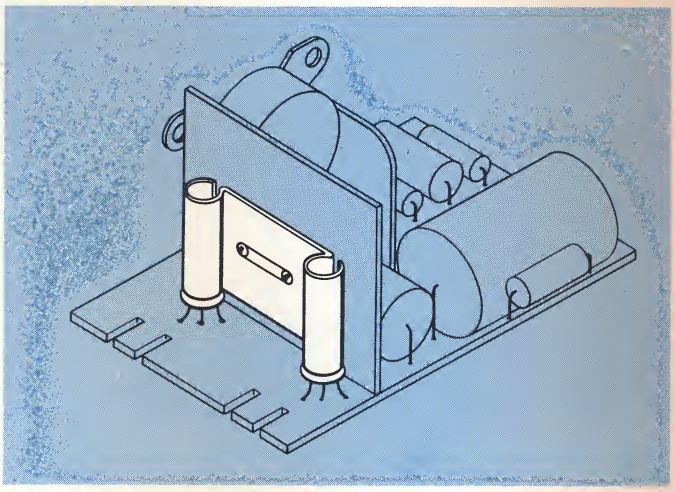
For more stringent cooling requirements. HS-3 shown holding two audio transistors for a maximum of heat dissipation.



AMPEREX

HSC-1

The single transistor Cooling Fin in a "tight spot" suggests its flexibility.



AMPEREX

HSC-2

Just as flexible and efficient as HSC-1 but holds two transistors.

TRANSISTOR HEAT SINKS

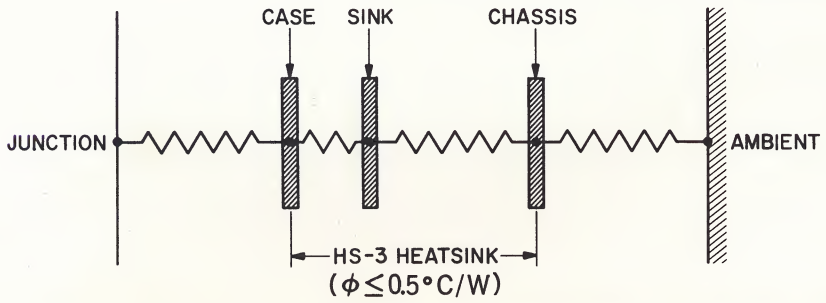
GENERAL INFORMATION

One primary factor influencing transistor power dissipation is junction temperature of the device under operating conditions. The relationship is expressed by:

$$P_d = \frac{T_J \text{ MAX} - T_A}{\phi}$$

where T_J MAX = maximum junction temperature
T_A = ambient temperature
ϕ = total thermal resistance

Total thermal resistance from junction to ambient is made up of a number of smaller thermal resistances in series. These are the thermal resistance from junction to case, from case to heat sink and from heat sink to ambient. The first of these (junction to case) is built into the transistor and is beyond the control of the user. Maximum power dissipation is achieved when the thermal resistance from the case to ambient is reduced to zero. This in effect, defines an "infinite heat sink" — where the case temperature is maintained at the same temperature as the ambient air.



Tackling the problem of achieving maximum transistor heat dissipation with TO-1 audio transistors Amperex has developed a low-cost line of extruded aluminum heat sinks.*

The Amperex "HS" series of heat sinks provide a low thermal resistance from case to ambient, permitting almost twice the power output of transistors used with previous heat sinks.

The Amperex extruded aluminum heat sinks are a practical commercial design. The clamping action provided by the angled configuration, provides the lowest thermal resistance possible at lowest cost. The deep cut fins provide considerable area for natural convection.

In addition, COOLING CLIPS are available for use in equipment where TO-1 transistor power requirements fall within lower ranges.

To achieve maximum heat dissipation, follow installation procedure on the next page.

*Patent pending

Amperex Extruded Aluminum Heat Sinks

- Grip the transistor for better bond
- Provide maximum heat dissipation
- Are installed easily
- Are available in three sizes. (Custom made Heat Sinks are also available)

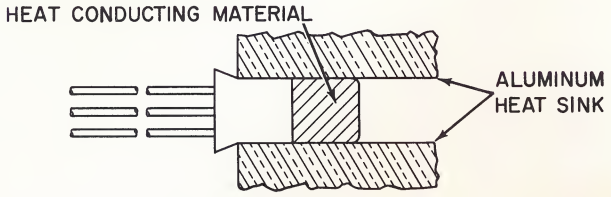
For lower cooling demands, Amperex clip-on Cooling Fins of Nickel Plated Brass

- Fit into smaller areas
- Are available in two types for single or dual transistor mounting

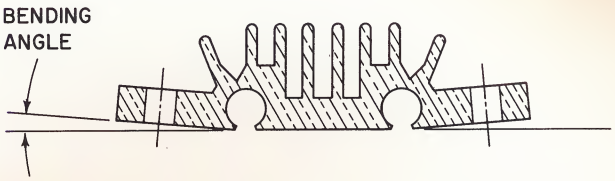
Amperex® Heat Sink Data

INSTALLATION PROCEDURE

Installation procedure for the Amperex extruded aluminum heat sink illustrates its functional design advantages. Insert TO-1 transistors into openings, up to the flared portion (as illustrated). Attaching heat sink to chassis, or other mounting surface, pulls down the angles of the heat sink flanges, which reduces the diameter of the opening holding the transistor, thereby gripping transistor casing to produce the lowest possible thermal resistance interface between transistor casing and heat sink. Producing lowest thermal resistance interface between case and heat sink provides an economical solution to the variations encountered in case diameters and extruded heat sink openings. For all practical purposes — attaching sink to chassis, makes for an almost infinite heat sink.



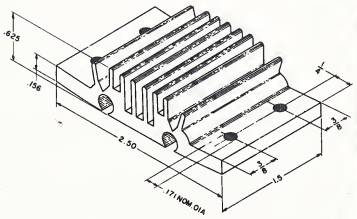
Amperex TO-1 Audio transistor inserted into extruded aluminum heat sink. Note that flared end is clear of heat sink. (Shaded area shows approximately ½ of TO-1 transistor filled with heat conducting material.)



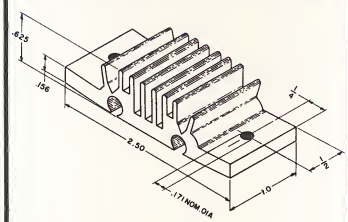
Bolting down extruded aluminum flanges produces tight bond which effectively reduces thermal resistance between case and ambient.

Heat Sink Specifications

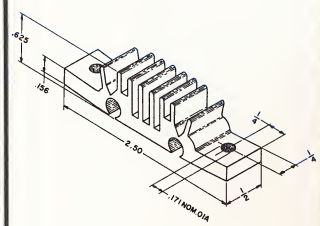
EXTRUDED ALUMINUM



HS-1

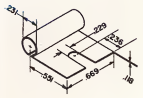


HS-2

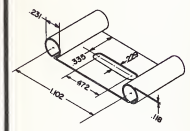


HS-3

CLIP ON HEAT SINK



HSC-1



HSC-2

Note: All measurements are made at ambient temperatures between 30° and 50°C.

HEAT SINKS MEASURED IN FREE AIR

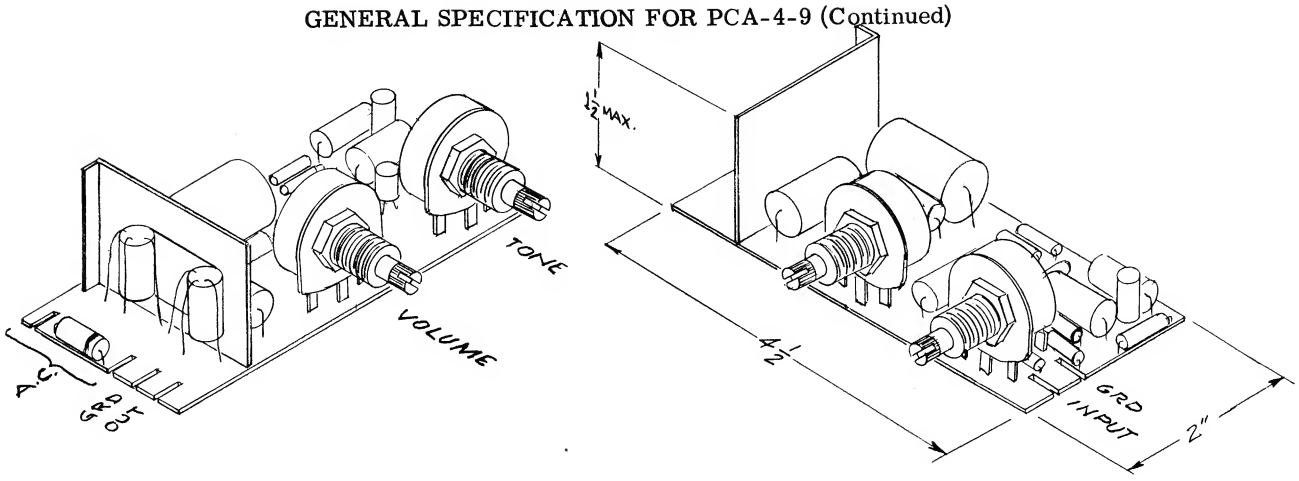
PART NO.	DESCRIPTION	AMBIENT TEMPERATURE
HSC-1	Single clip-on, one transistor	43°C/W

HEAT SINKS MOUNTED ON 2½ x 2½ x 3/32 ALUMINUM PLATE (which has a thermal resistance of approx. 12° C/W)

		THERMAL RESISTANCE FROM CASE TO AMBIENT
HSC-2	Dual clip-on, two transistors	20°C/W
HS-3	½-inch extruded aluminum, two transistors	12°C/W

HS-3/66

PRINTED IN U.S.A.

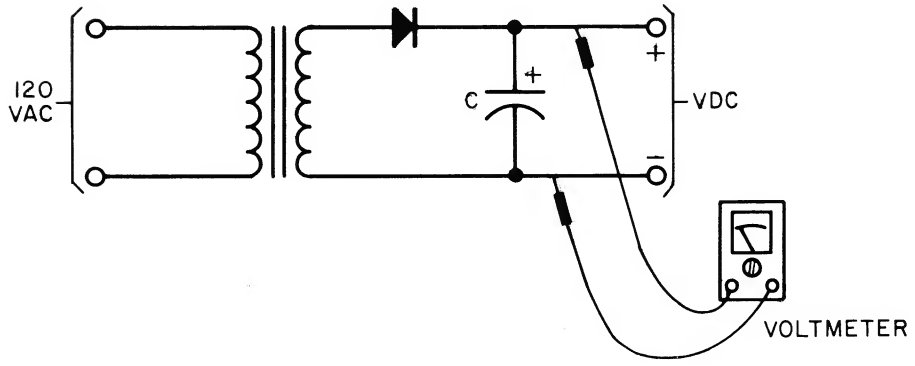


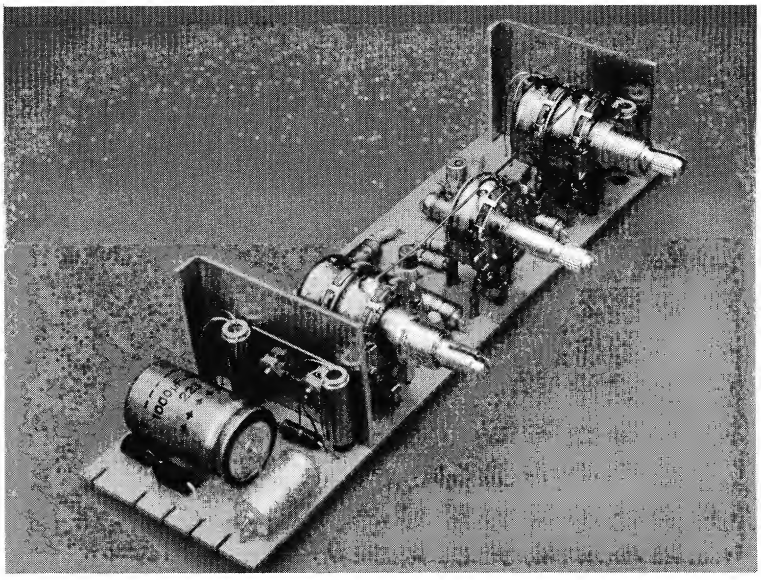
PCA-4-9

SUGGESTED POWER TRANSFORMER SPECIFICATIONS FOR PCA-4-9

Circuit Diagram:	Half Wave
Filter Capacitor:	C = 1600 uf
Silicon Diodes:	500 ma
DC Voltage Output:	11V max @ 10 ma 8.8V min @ 160 ma

This power supply feeds a Class B amplifier so that temperature rise may be measured at 60% of full output.





TENTATIVE SPECIFICATION FOR PCA-5A-14

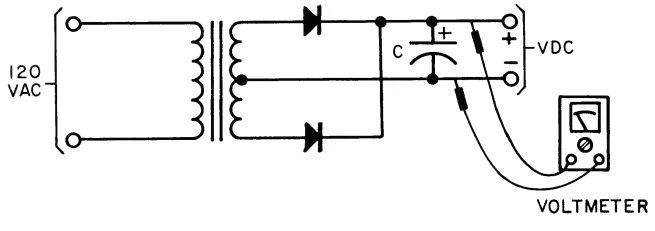
Supply Voltage:	14V DC (Regulated for measurement purposes)
Load Impedance:	8 ohms
Input Impedance:	600K ohms avg 330K ohms min
Input Sensitivity for 1.8W:	1.0V avg
Power Output:	1.8W @ 10% distortion @ 1 KHz @ 8 ohms
Idle Current:	20 ma
Maximum Current for 1.8W:	210 ma
Frequency Response:	@ 1W @8 ohms 100 Hz - 40 KHz @ -3 db
Tone Controls:	Treble + 0 db -12 db @10 KHz
Power vs Total Harmonic Distortion:	@1 KHz @8 ohms

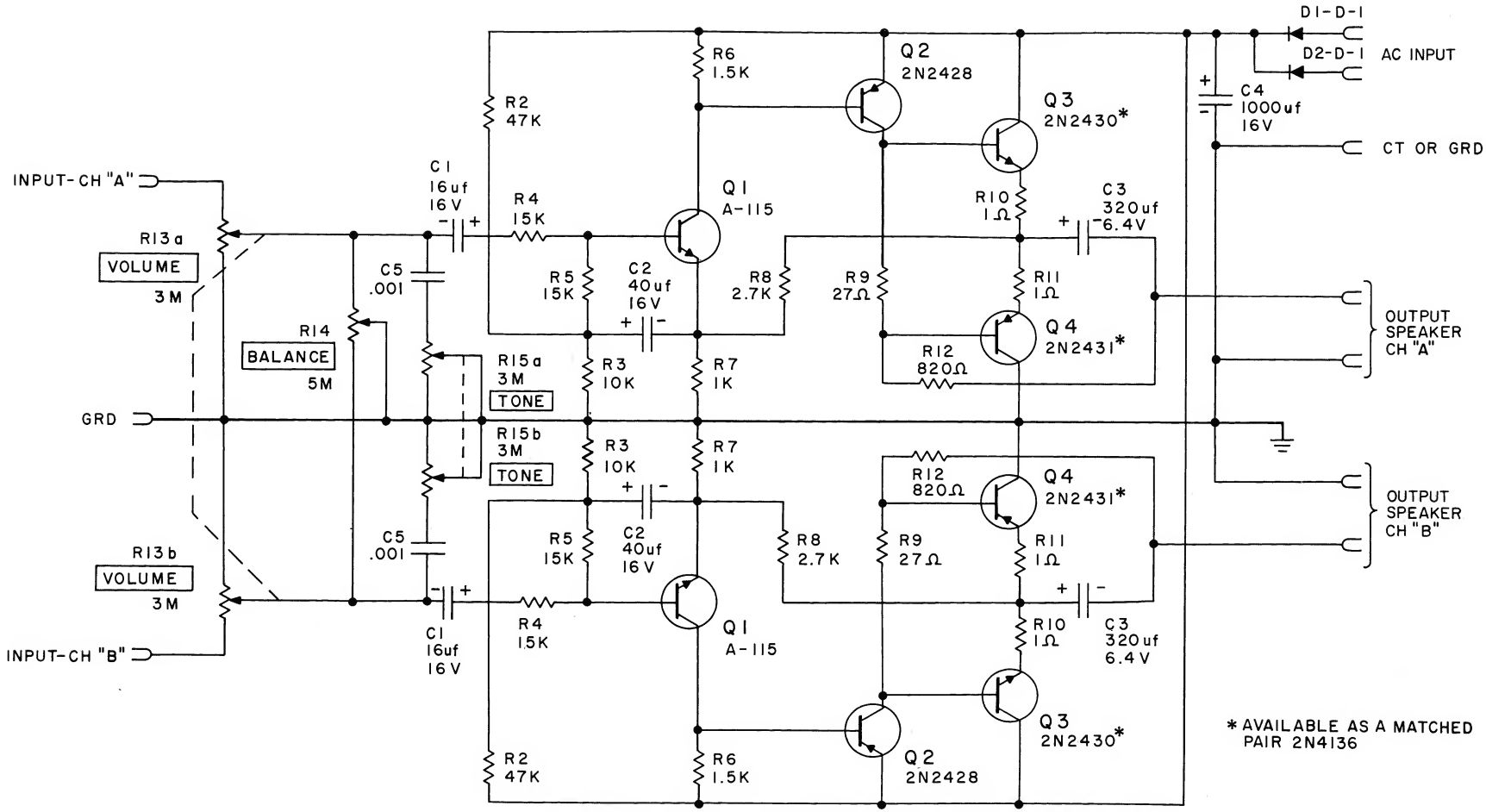
0.1W	0.25%
0.5W	0.55%
1.0W	0.95%
1.5W	2.2%
2.0W	12.0%

SUGGESTED POWER TRANSFORMER SPECIFICATIONS FOR PCA-5A-14

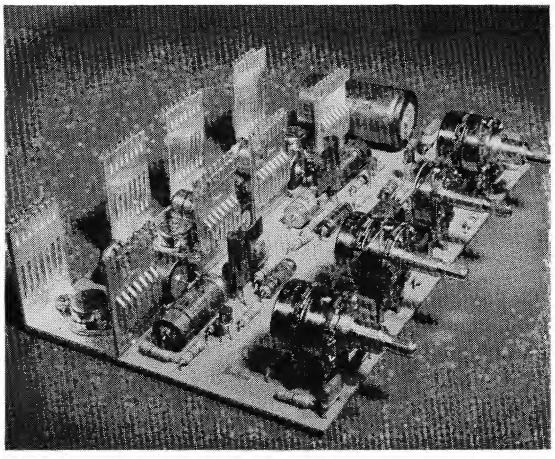
Circuit Diagram:	Full Wave Center Tapped Secondary
Filter Capacitor:	C = 1000 uf
Silicon Diodes:	use 500 ma
DC Voltage Output:	14.5V max @ 20 ma 12.0V min @450 ma

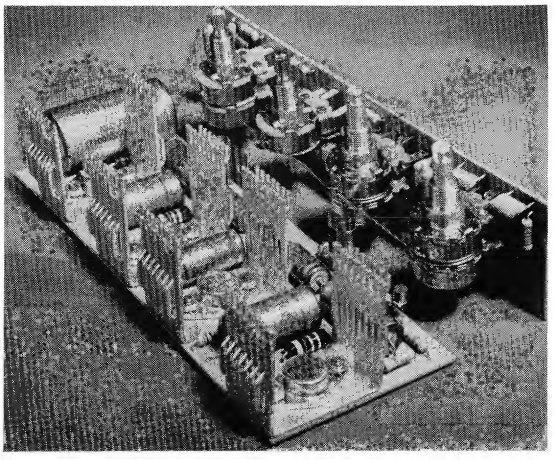
This power supply feeds a Class B amplifier so that temperature rise may be measured at 60% of full output.




D1-D-1
D2-D-1
AC INPUT
C4
1000uf
16V
CT OR GRD
R6
1.5K
Q2
2N2428
Q3
2N2430*
R2
47K
C1
16uf
16V
R4
15K
Q1
A-115
R10
1Ω
C3
320uf
6.4V
INPUT-CH "A"
R13a
VOLUME
3M
C5
.001
R5
15K
C2
40uf
16V
R8
2.7K
R9
27Ω
R11
1Ω
Q4
2N2431*
R14
BALANCE
5M
R15a
3M
TONE
R12
820Ω
OUTPUT
SPEAKER
CH "A"
GRD
R3
10K
R7
1K
R15b
3M
TONE
OUTPUT
SPEAKER
CH "B"
R13b
VOLUME
3M
INPUT-CH "B"
* AVAILABLE AS A MATCHED
PAIR 2N4136

PCA-5A-14





TENTATIVE SPECIFICATION FOR PCA-6A-25

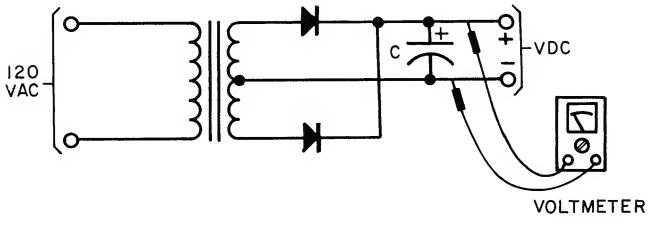
Supply Voltage:	25V DC (Regulated for measurement purposes)
Load Impedance:	8 ohms
Input Impedance:	500K ohms avg
Input Sensitivity for 9.5W:	0.5V avg
Power Output:	9.5W @ 10% distortion 1 KHz @ 8 ohms
Idle Current:	35 ma
Maximum Current for 9.5W:	560 ma
Frequency Response:	@ 1W @ 8 ohms
	30 Hz - 40 KHz @ -3 db
Tone Controls:	Treble + 3 db -14 db @ 10 KHz
	Base + 10 db -10 db @ 100 Hz
Power vs Total Harmonic Distortion:	@ 1 KHz @ 8 ohms

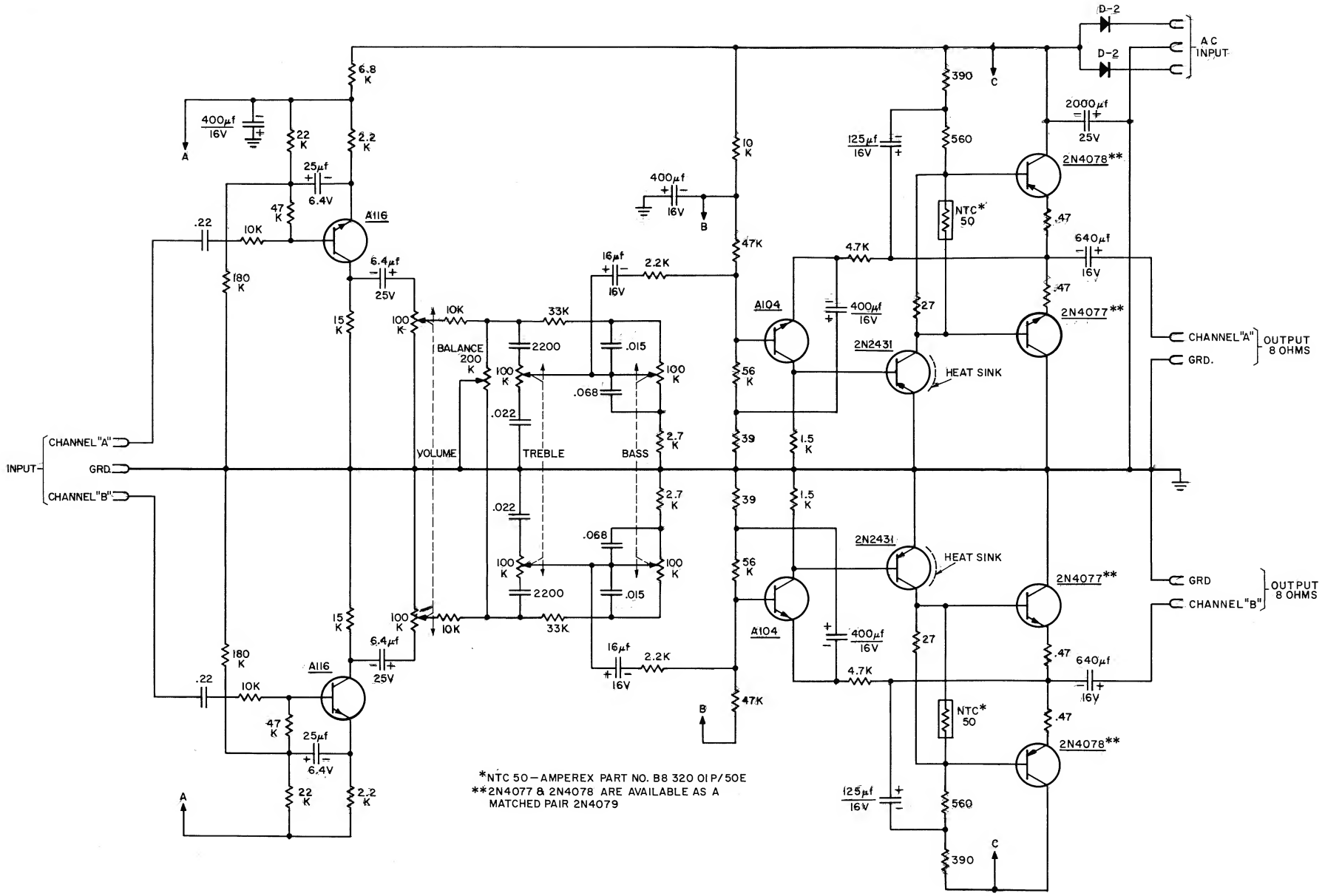
0.1W	0.6%
1.0W	0.5%
2.5W	1.1%
5.0W	2.0%
7.5W	3.2%
9.5W	10.0%

TENTATIVE SUGGESTED POWER TRANSFORMER SPECIFICATIONS FOR PCA-6A-25

Circuit Diagram:	Full Wave Center Tapped Secondary
Filter Capacitor:	C = 2000 uf
Silicon Diodes:	750 ma
DC Voltage Output:	26V max @ 40 ma 23V min @ 1.1 amps

This power supply feeds a Class B amplifier so that temperature rise may be measured at 60% of full output.



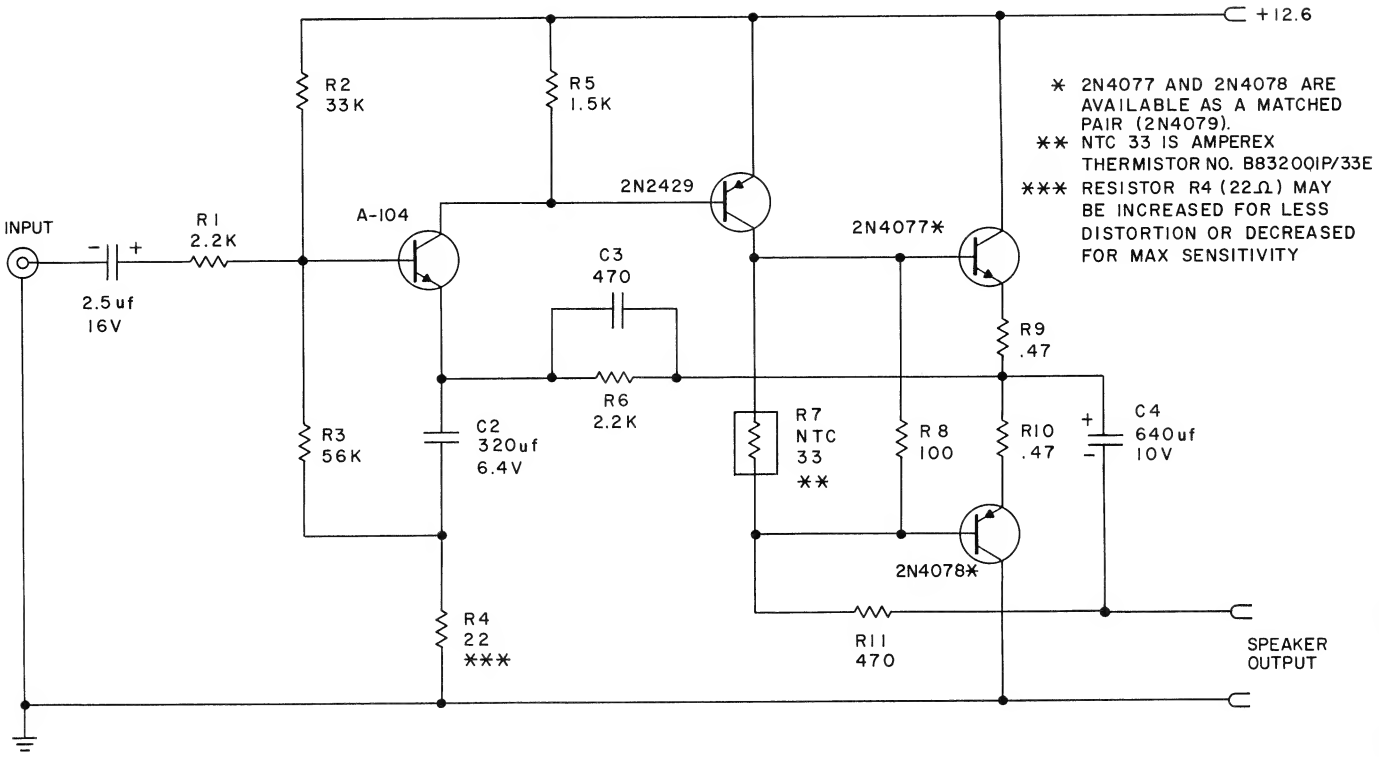

D-2
D-2
AC INPUT
6.8 K
400µf 16V
22 K
2.2 K
25µf 6.4V
47 K
A116
.22
10K
180 K
6.4µf 25V
15 K
100 K
10K
33K
BALANCE 200 K
2200
.015
100 K
.068
.022
2.7 K
VOLUME
TREBLE
BASS
CHANNEL "A"
INPUT
GRD
CHANNEL "B"
16µf 16V
2.2K
400µf 16V
10 K
47K
56 K
39
1.5 K
A104
2N2431
HEAT SINK
390
560
125µf 16V
2000µf 25V
2N4078**
NTC* 50
.47
640µf 16V
4.7K
27
2N4077**
CHANNEL "A"
GRD.
OUTPUT 8 OHMS
GRD
CHANNEL "B"
*NTC 50 — AMPEREX PART NO. B8 320 01 P/50E
**2N4077 & 2N4078 ARE AVAILABLE AS A MATCHED PAIR 2N4079

PCA-6A-25

GENERAL SPECIFICATION FOR 5W AUTO RADIO OUTPUT

Supply Voltage:	12.6 - 13.6V
Load Impedance:	3.2 - 4.0 ohms
Input Impedance:	20K ohms
Input Sensitivity for 4 W:	0.085V RMS
Power Output:	4W @ 10% distortion @ 1 KHz @ 4.0 ohms 5W @ 10% distortion @ 1 KHz @ 3.2 ohms
Idle Current:	20 - 26 ma
Maximum Current for 4W:	540 ma
Frequency Response:	@ 1W @ 4 ohms 65 Hz - 25 KHz @ -3 db (640 uf output)
Maximum Temperature:	60°C (140°F) @ 12.6V
Power vs Total Harmonic Distortion:	@ 1 KHz @ 4 ohms

0.1W	1.2%
0.5W	1.4%
1.0W	1.5%
2.5W	2.2%
3.5W	5.0%
4.0W	10.0%

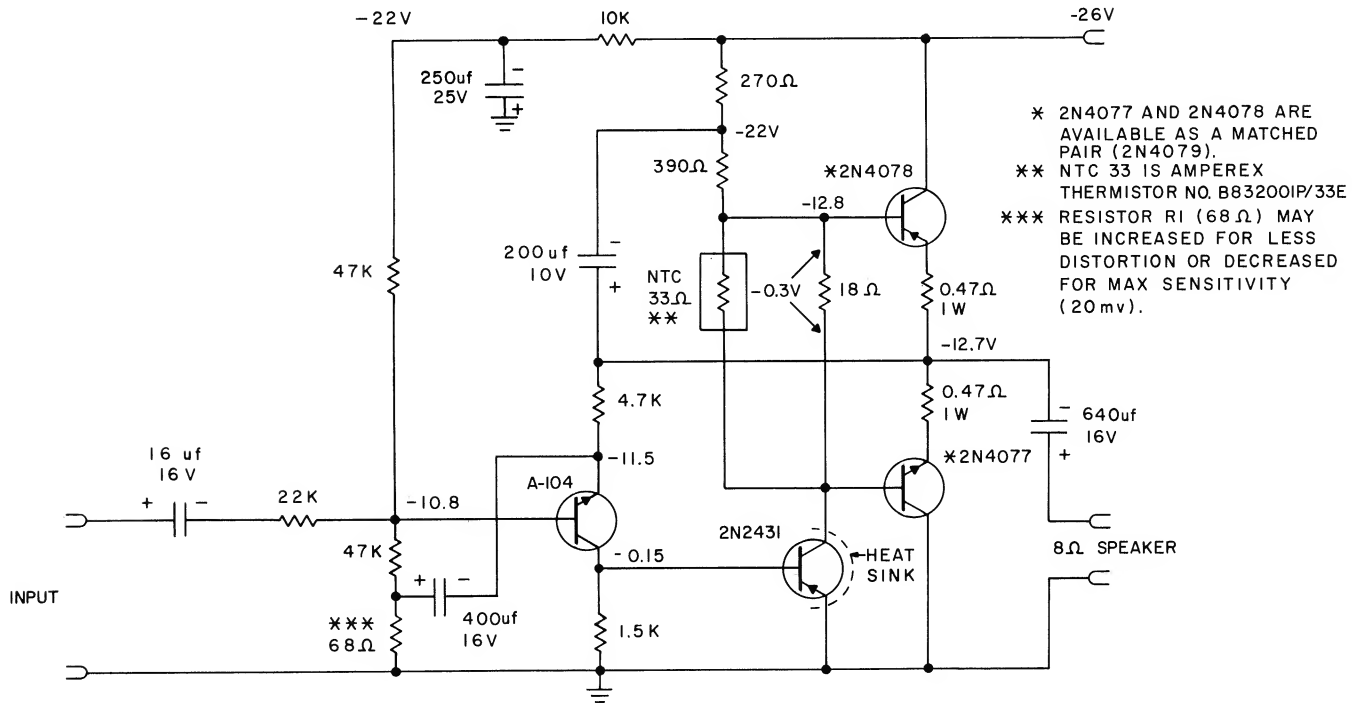


BASIC 5W AUTO RADIO AMPLIFIER

GENERAL SPECIFICATION FOR 10W COMPLEMENTARY SYMMETRY AMPLIFIER

Supply Voltage:	26V
Load Impedance:	8 ohms
Input Impedance:	40K ohms min.
Input Sensitivity for 10W:	0.20V RMS
Power Output:	10W @ 6.3% distortion @ 1 KHz @ 8 ohms
Idle Current:	30 ma
Maximum Current for 10W:	560 ma
Frequency Response:	@ 1W @ 8 ohms 24 Hz - 65 KHz @ -3 db
Power vs Total Harmonic Distortion:	@ 1 KHz @ 8 ohms

0.1W	0.20%
0.5W	0.42%
1.0W	0.62%
2.5W	1.0 %
5.0W	1.5 %
7.5W	2.2 %
10.0W	6.3 %

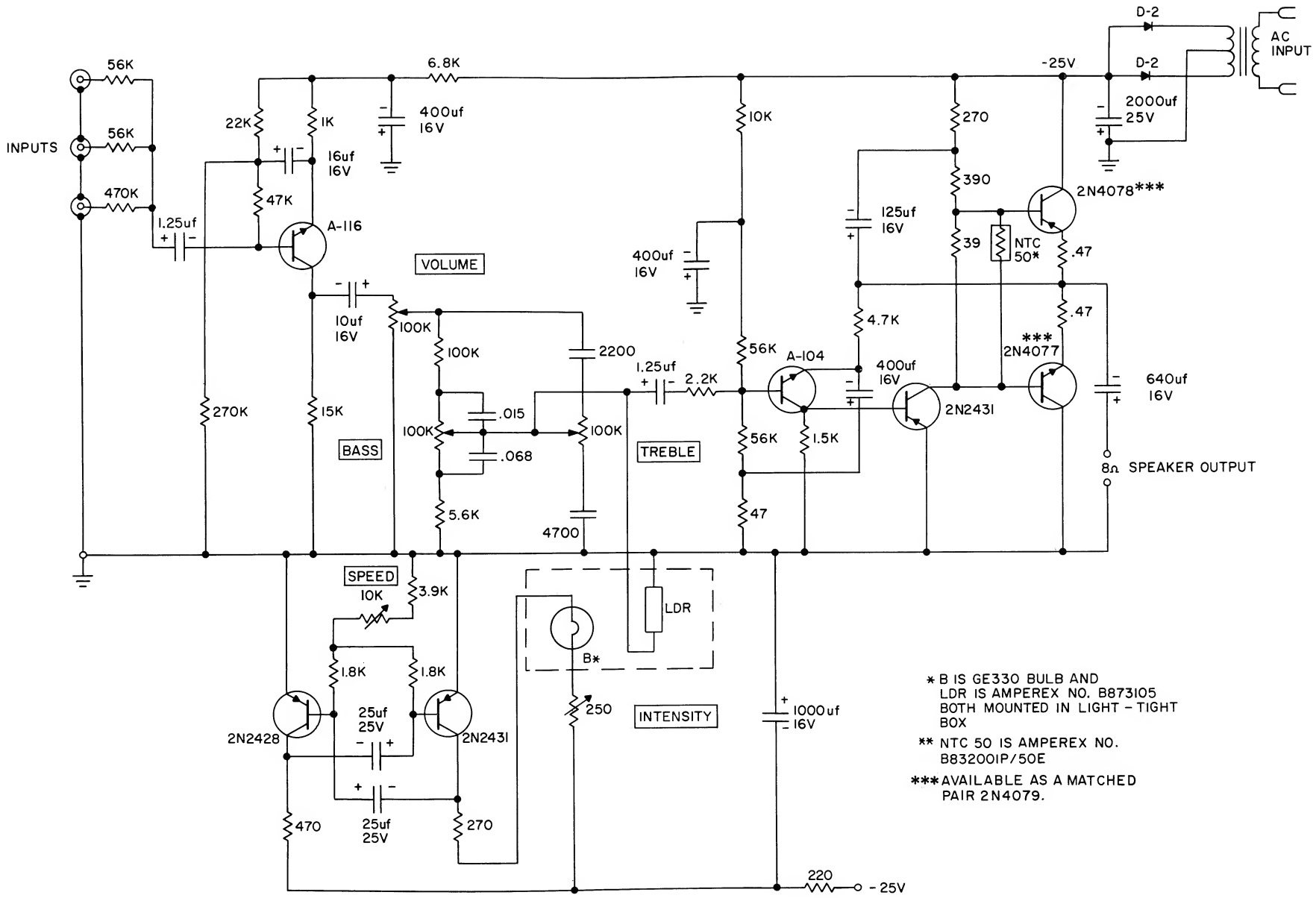


COMPLEMENTARY SYMMETRY BASIC AMPLIFIER

GENERAL SPECIFICATION FOR GUITAR AMPLIFIER WITH TREMOLO

Supply Voltage:	25V @ 70 ma 23.8V @ 550 ma
Load Impedance:	8 ohms
Input Impedance:	three inputs; two at 150K ohms min; one at 560K ohms min.
Input Sensitivity for 5W:	100 m V
Frequency Response:	@ 1W @ 8 ohms 20 Hz - 30 KHz @ -3 db
Tone Controls:	Treble +13 db -10 db Bass + 1 db -10 db
Tremolo Range:	2-7 Hz
Overload:	0.5V RMS
Modulation:	2 Hz 90% 7 Hz 40%
Power vs Total Harmonic Distortion:	@ above supply regulation

0.1W	1.2%
0.5W	0.8%
1.0W	0.7%
2.5W	1.0%
5.0W	1.8%
7.5W	5.6%
8.2W	10.0%



* B IS GE330 BULB AND LDR IS AMPEREX NO. B873105 BOTH MOUNTED IN LIGHT - TIGHT BOX

** NTC 50 IS AMPEREX NO. B83200IP/50E

*** AVAILABLE AS A MATCHED PAIR 2N4079.

8W GUITAR AMPLIFIER WITH TREMOLO

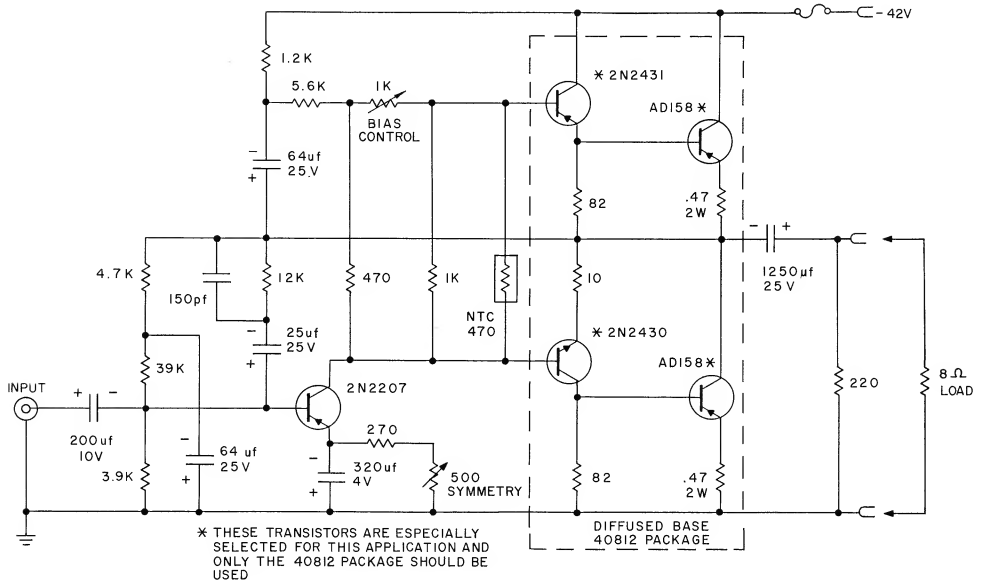
TENTATIVE

GENERAL SPECIFICATION FOR 20 WATT HI-FI AMPLIFIER USING THE 40812 KIT

Supply Voltage:	42V DC (Regulated for measurement purposes)
Load Impedance:	8 ohms
Input Impedance:	2.2K ohms min
Input Sensitivity for 20W:	2.5V RMS @ 8 ohms
Power Output:	28W @ 10% distortion @ 1KHz @ 8 ohms 25W @ 5% distortion @ 1KHz @ 8 ohms 20W @ 1% distortion @ 1KHz @ 8 ohms
Frequency Response:	@ 1W @ 8 ohms 16 Hz - 55 KHz @ -3db
Power vs Total Harmonic Distortion:	@ 8 ohms

Power	20 Hz	50 Hz	100 Hz	1 KHz	10 KHz	20 KHz
0.1W	.65	.55	.42	.25	.30	.30
0.5W	.65	.55	.42	.25	.30	.30
1W	.60	.55	.42	.25	.30	.30
5W	.65	.55	.45	.25	.33	.30
10W	.90	.58	.48	.25	.38	.35
12W	1.00	--	--	--	--	--
15W	--	.65	.52	.32	.48	.58
17W	--	1.00	--	--	--	1.00
20W	--	--	1.00	1.00	1.20	--

Rise Time:	4 usec (Fall 4 usec.)
Fuse:	1A for music operation only



BASIC AMPLIFIER 20W Hi-Fi

TECHNICAL DATA - TRANSISTORS

(PAGES 30-38)

TENTATIVE

GENERAL DESCRIPTION

The Amperex A-105 thru A-110 are NPN silicon planar transistors in a TO-18 case intended for use as low level audio amplifiers and drivers.

ELECTRICAL CHARACTERISTICS (T = 25°C)

	Symbol	Min	Max	Units
Base-Emitter Bias Voltage I_C = 1 ma, I_b = 0.1 ma	V_{BE}	0.6	0.8	Volts
Collector-Emitter Breakdown Voltage I_C = 10 ma	BV_{CEO}	20	--	Volts
Collector-Base Leakage Current V_{CB} = 20V	I_{CBO}	--	100	na
Collector-Emitter Leakage Current V_{CE} = 5V, I_b = 0	I_{CEO}	--	50	na
Emitter-Base Leakage Current V_{EB} = 4V	I_{EBO}	--	100	na
Static Forward Current Transfer Ratio I_C = 5 ma, V_{CE} = 5V	h_{FE}			
	(A-105, A-106)	90	220	
	(A-107, A-108)	180	440	
	(A-109, A-110)	360	880	
Collector-Emitter Saturation Voltage I_C = 5 ma, I_b = 0.5 ma	$V_{CE(sat)}$			
	(A-106, A-108, A-110)		0.25	Volts
I_C = 1 ma, I_b = 0.1 ma	(A-105, A-107, A-109)		0.35	Volts

The A-106, A-108 and A-110 have low saturation voltages for audio driver applications.

TENTATIVE

GENERAL DESCRIPTION

The Amperex A-104, A-115, and A-116 are NPN silicon planar transistors in a TO-18 case intended for use as a low level audio amplifier. Characterized by a high gain at 100 microamperes, these transistors also feature a low noise figure, making them particularly useful in preamplifier input stages.

ELECTRICAL CHARACTERISTICS (T = 25°C)

	Symbol	Min	Max	Units
Base-Emitter Bias Voltage I_C = 1 ma, I_b = 0.1 ma	V_{BE}	0.6	0.8	Volts
Collector-Emitter Breakdown Voltage I_C = 10 ma	BV_{CEO}	20	--	Volts
Collector-Base Leakage Current V_{CB} = 20V	I_{CBO}	--	100	na
Collector-Emitter Leakage Current V_{CE} = 5V, I_b 0	I_{CEO}	--	50	na
Emitter-Base Leakage Current V_{EB} = 4V	I_{EBO}	--	100	na
Static Forward Current Transfer Ratio I_C = 100 u a, V_{CE} 5V	h_{FE}(A-104)	100	300	
	(A-115)	50	100	
	(A-116)	100	300	
Wide Band Noise Figure I_C = 10 u a	WBNF(A-104)		4	db
	(A-115)		4	db
	(A-116)		*	db

*A-116 is controlled for very low $\frac{1}{f}$ noise.

TENTATIVE

GENERAL DESCRIPTION

The Amperex A-111 is an NPN silicon epitaxial transistor in a TO-18 case, intended for use in medium current audio amplifier stages. Characterized by a high gain at 20 milliamperes, the A-111 also features a low saturation voltage, making it particularly useful in driver stages.

ELECTRICAL CHARACTERISTICS (T = 25°C)

	Symbol	Min	Max	Units
Collector-Emitter Saturation Voltage I_C = 20 ma, I_b = 2 ma	$V_{CE(sat)}$	--	0.35	Volts
Collector-Emitter Breakdown Voltage I_C = 10 ma	BV_{CEO}	30	--	Volts
Collector-Base Leakage Current V_{CB} = 20V	I_{CBO}	--	100	na
Collector-Emitter Leakage Current V_{CE} = 5V, I_b = 0	I_{CEO}	--	50	na
Emitter-Base Leakage Current V_{EB} = 4V	I_{EBO}	--	100	na
Static Forward Current Transfer Ratio I_C = 20 ma, V_{CE} = 5V	h_{FE}	180	440	

TENTATIVE

GENERAL DESCRIPTION

The Amperex AD158 is an alloy-diffused PNP germanium power transistor in a TO-3 case, intended for use in the Class B output stage of Hi-Fi Amplifiers.

ABSOLUTE MAXIMUM RATINGS

	Symbol	Value
Collector-Base Voltage	V_{CB}	75 Volts
Collector Current	I_C	5.0 amp
Base Current	I_B	0.5 amp
Power Dissipation (T_{MB} = 81°C)	P_C	12.5 watts
Junction Temperature		
Operating	T_j	100°C
Storage	T_{stg}	-35 to 100°C

STATIC ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

	Symbol	Min	Max	Units
Thermal Derating Factor	T_{jc}	--	1.5°	c/w
Collector Cut-off Current				
V_{CB} = 0.5V, I_E = 0	I_{CBO}	--	0.2	ma
V_{CB} = 15V, I_E = 0, Tj = 100°C	I_{CBO}	--	25	ma
Collector-Base Breakdown Voltage				
I_C = 10 ma, V_{BE} = 1V	BV_{CBO}	75	--	Volts
Collector-Emitter Breakdown Voltage				
I_C = 2 amp, I_B = 0	BV_{CEO}	40	--	Volts
Emitter-Base Breakdown Voltage				
I_{EB} = 10 ma, I_C = 0	BV_{EBO}	2.5	--	Volts
Forward Current Transfer Ratio				
I_E = 30 ma, V_{CB} = 14V	h_{FE}	40	300	
I_E = 1 amp, V_{CB} = 2V	h_{FE}	75	220	
I_E = 3 amp, V_{CB} = 2V	h_{FE}	40	160	
Base Input Voltage				
I_E = 30 ma, V_{CB} = 14V	V_{BE}	170	210	mV

DYNAMIC ELECTRICAL CHARACTERISTICS (T_A = 25°C)

	Symbol	Typ	Units
Cut-off Frequency			
I_E = 0.5 amp, V_{CB} = 2V	f_t	20	mc

Consisting of
1 - 2N2430 (NPN)
2 - 2N2706 (PNP)

TENTATIVE DATA

GENERAL DESCRIPTION

The 2N2707 is a complementary (NPN-PNP) matched pair of germanium (TO-1) transistors intended for use in transformerless audio output or driver stages. It can deliver 1 watt of sine wave power into a 8 or 16 ohm load.

Absolute Maximum Ratings

Collector-Base Voltage	V_{CBO}	32V
Emitter-Base Voltage	V_{EBO}	10V
Collector Current	I_C	200 ma.
Base Current	I_B	10 ma.
Storage & Operating Tem. Range (junction)	T_j	-65° to 100°C

ELECTRICAL CHARACTERISTICS 25°C

		Min.	Typ.	Max.
Forward Current Transfer Ratio (I_C = 50 ma., V_{CB} = 0)	h_{FE}	65	--	200
Collector-Base Leakage (V_{CB} = 10V.)	I_{CBO}	--	--	10 μA
Freq. at which $/h_{FE}/ = 1$ (V_{CB} = 2V., I_E = 10 ma.)	f_1	1.3	--	--Mc
Collector-Emitter Knee Voltage I_c = 0.2A (I_B set for I_c = 0.22A V_{CE} = 1 V.)	V_{CE}(sat)	--	--	0.5V.

DEVICE DISSIPATION

Power Dissipation at 25°C ambient with cooling clip mounted to 2 1/2" x 2 1/2" x 3/32" aluminum plate.	2N2430	0.5 watt
	2N2706	1.0 watt
Thermal Resistance, Junction to Case	2N2430	110°C/watt
	2N2706	50°C/watt

Consisting of
1 - 2N4077 (NPN)
1 - 2N4078 (PNP)

TENTATIVE DATA

The Amperex 2N4079 is a pair of germanium transistors selected to operate in a complementary symmetry audio power output circuit.

The 2N4079 requires no input or output transformers and is capable of delivering up to 12 watts of audio in Class B operation.

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	V_{CBO}	32 V
Collector-Emitter Voltage	V_{CEO}	20 V
Emitter-Base Voltage	V_{EBO}	10 V
Collector Current (Cont.)	I_C	1 A
Collector Current (Peak)	I_{CM}	3 A

TEMPERATURE

Storage Temperature range, T_{stg}	-55°C to 100°C	
Operating Junction Temperature Range, T_j	-55°C to 100°C	
Lead temperature, 3/16" from case for 10 seconds		230°C

DEVICE DISSIPATION

Power dissipation at 25°C case with heat sink		7.5 W
Thermal Resistance (Junction to Case)	T_{jc}	4.5°C/watt

ELECTRICAL CHARACTERISTICS, 25°C CASE TEMPERATURE

		Min.	Max.
Collector cutoff current, (V_{CB} = 10 v, I_E = 0)	I_{CBO}		25 μa
Emitter cutoff current, (V_{EB} = 10 v, I_C = 0)	I_{EBO}		0.2 ma
Collector-emitter breakdown voltage,	BV_{CEO}	20V	

		Min.	Max.
ELECTRICAL CHARACTERISTICS, 25°C CASE TEMPERATURE			
Collector-emitter saturation voltage. (I_C = 1.0 a, I_B = 10 Ma)	$V_{CE(sat)}$		0.8 v
DC forward current transfer ratio, (I_C = 500 Ma, V_{CB} = 0 v)	h_{FE}	75	250
Base-emitter voltage, (I_C = 500 Ma, V_{CE} = 1.5 v)	V_{BE}		0.6 v
Base-emitter voltage, (for Class B operation) (I_C = 5 Ma, V_{CE} = 10 v)	V_{BE}	110	150 mv
DYNAMIC			
Gain bandwidth product, (V_{CE} = 2 v, I_C = 10 Ma)	f_T	1.0	Mc

PAIRS

Pairs are matched into h_{FE} categories at 500 ma.

Consisting of
1 - 2N4105 (NPN)
1 - 2N4106 (PNP)

TENTATIVE DATA

GENERAL DESCRIPTION

The 2N4107 is a complementary (NPN-PNP) matched pair of germanium (TO-1) transistors, intended for use in transformerless audio output or driver stages. The 2N4107 pair mounted in a HS-3 heatsink can deliver 5 watts of power into an 8 ohm load.

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	V_{CBO}	25V
Collector-Emitter Voltage	V_{CEO}	15V
Emitter-Base Voltage	V_{EBO}	10V
Collector Current	I_C	1A
Peak Collector Current	I_{CM}	2A
Storage & Operating Temperature Range (junction)	T_j	-55°C to 100°C
Total Dissipation at 25°C case	P_t	1.6W
Thermal Derating Factor in HS-3 Heat Sink	T_{j-c}	35°C/W max.

ELECTRICAL CHARACTERISTICS 25°C

		Min.	Typ.	Max.
Forward Current Transfer Ratio (at I_C = 0.5 A, V_{CB} = 0)	h_{FE}	100	--	500
Collector-Base Leakage (V_{CB} = 10V)	I_{CBO}	--	--	20 μa
Freq. at which $\lvert h_{FE} \rvert = 1$ (V_{CB} = 2V, I_E = 10 ma)	f_T	--	1.5	-- Mc
Collector-Emitter Knee Voltage I_C = 1A (I_B set for I_C = 1.1A at V_{CE} = 1V)	$V_{CE(sat)}$	--	--	0.7V

DEVICE DISSIPATION

Power Dissipation at 25° Case	1.6 watt (each unit)
Derating Factor	40°C/watt (35°C/watt in HS-3)

Consisting of
1 - 2N2430 (NPN)
1 - 2N2431 (PNP)

TENTATIVE DATA

GENERAL DESCRIPTION

The 2N4136 is a complementary (NPN-PNP) matched pair of germanium (TO-1) transistors, intended for use in transformerless audio output or driver stages. It can deliver 2 watts of sine wave power into a 8 ohm load.

ABSOLUTE MAXIMUM RATING

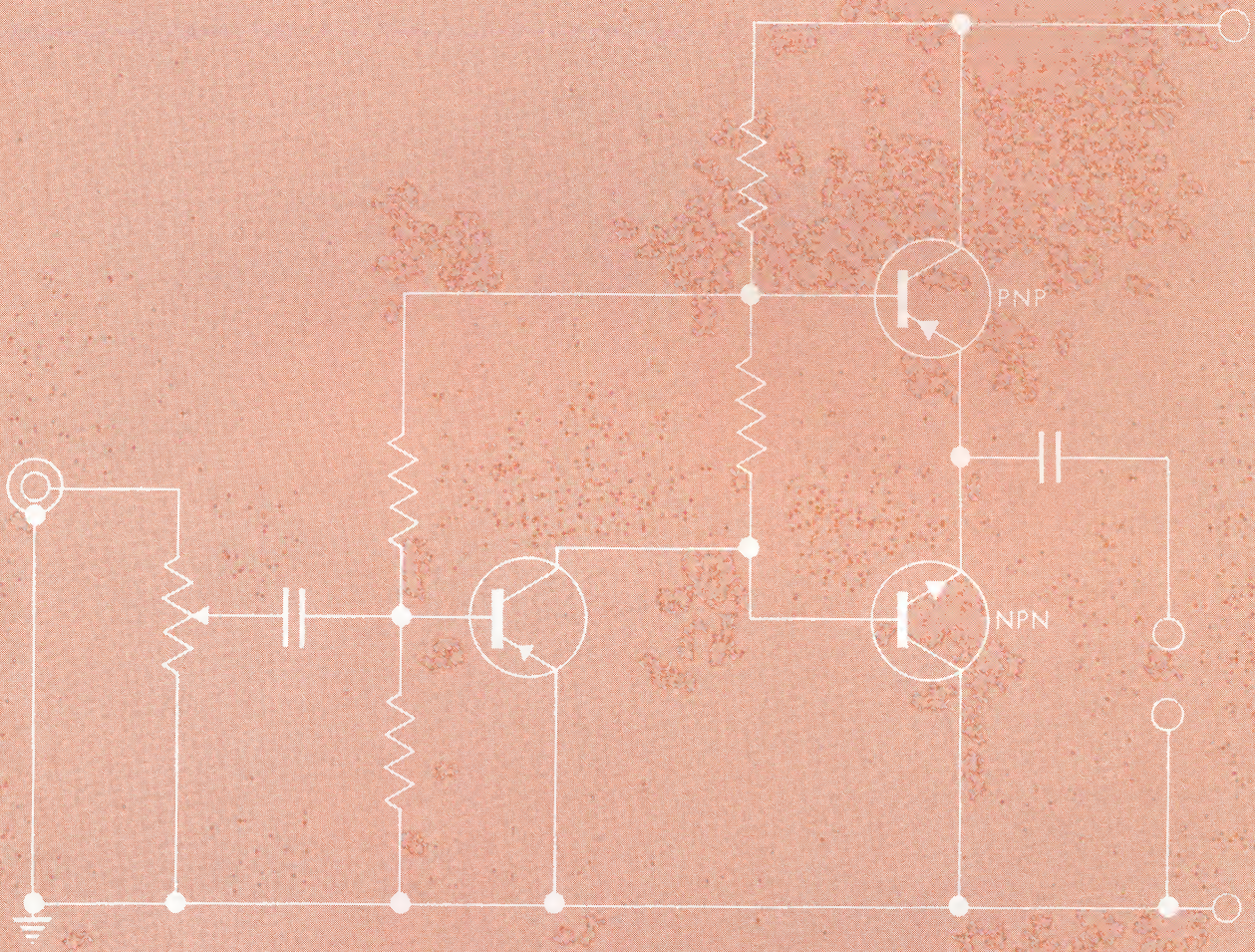
Collector-Base Voltage	V_{CBO}	32 V
Emitter-Base Voltage	V_{EBO}	10 V
Collector Current	I_C	500 ma
Base Current	I_B	25 ma
Storage & Operating Temperature Range (junction)	T_j	-65°C to 100°C

ELECTRICAL CHARACTERISTICS 25°C

		Min.	Typ.	Max.
Forward Current Transfer Ratio (I_C = 50 ma., V_{CB} = 0)	h_{FE}	50	--	220
Collector-Base Leakage (V_{CB} = 10V.)	I_{CB0}	--	--	15 μA
Emitter Cutoff Current (V_{EB} = 5V.)	I_{EBO}	--	--	45 μA
Freq. at which $/h_{FE}/ = 1$ (V_{CB} = 2V., I_E = 10 ma)	f_1	1	--	-- Mc
Collector-Emitter Knee Voltage I_C = 0.5A (I_B set for I_C = 0.55 at V_{CE} = 1V.)	V_{CE}(sat)	--	--	0.7V

DEVICE DISSIPATION

Power Dissipation at 25°C ambient with cooling clip mounted to 2 1/2" x 2 1/2" x 3/32" aluminum plate.	2N2430	0.5 watt
	2N2431	1.25 watt
Thermal Resistance, Junction to Case	2N2430	110°C/watt
	2N2431	40°C/watt (35°C/watt in HS-3)



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